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Vaginal Breech Birth: Learnings from 21 Years of Retrospective Data Analysis

Die vaginale Beckenendlagengeburt: Erkenntnisse einer retrospektiven Analyse von Daten aus 21 Jahren

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ABSTRACT

Introduction
Optimal delivery mode for vaginal breech birth at term remains controversial, with varying recommendations across international guidelines. This study aimed to evaluate common perceptions and outcomes associated with VBB using retrospective data, including benefits of cesarean section, maternal and neonatal risks.

Material and Methods
We conducted a monocentric, retrospective cohort study over 21 years at a German tertiary perinatal center, examining term breech deliveries. Outcomes were compared between planned cesarean section and intended vaginal breech birth, with the latter group further categorized by successful and unsuccessful vaginal breech birth attempts.

Results
Of all deliveries, 3.6 % (3172) were singleton breech presentations beyond 36 weeks gestation. Among these, 2501 cases (78.8 %) were planned cesarean sections, while 671 cases (21.2 %) were intended vaginal breech births. Within the intended vaginal breech birth group, 524 (78 %) achieved vaginal delivery, whereas 147 (22 %) required secondary cesarean section. Maternal outcomes showed significant differences in blood loss ($p < 0.001$) and hospital stay ($p < 0.001$), favoring the vaginal breech birth group with lower blood loss and shorter hospital stays. However, neonatal interventions, including bag-mask ventilation and resuscitation, were significantly more frequent in the vaginal breech birth group ($p < 0.001$), along with increased short-term neonatal morbidity such as neonatal infections ($p < 0.001$), transient tachypnea ($p = 0.002$), and hypoxic-ischemic encephalopathy ($p = 0.008$).

Conclusion
The findings highlight an increase in intended vaginal breech births with a high rate of successful vaginal deliveries. Vaginal breech birth was associated with fewer maternal complications but elevated short-term neonatal morbidity. The re-

sults underscore the importance of individualized counseling and skilled provider presence when considering vaginal breech birth, supporting informed maternal choice and optimized delivery outcomes.

ZUSAMMENFASSUNG

Einleitung
Der optimale Entbindungsmodus für eine termingerechte vaginale Geburt aus Beckenendlage wird immer noch kontrovers diskutiert. Die in internationalen Richtlinien gemachten Empfehlungen variieren. Ziel dieser Studie war eine Evaluierung der verbreiteten Auffassungen sowie den mit einer vaginalen Beckenendlagengeburt assoziierten Ergebnissen. Hierzu wurden retrospektive Daten verwendet, die auch die Vorteile einer Kaiserschnittentbindung sowie mütterliche und neonatale Risiken berücksichtigten.

Material und Methoden
Es wurde eine monozentrische retrospektive Kohortenstudie über einen Zeitraum von 21 Jahren in einem deutschen Perinatalzentrum der Tertiärversorgung zur Untersuchung von termingerechten Entbindungen in Beckenendlage durchgeführt. Die Ergebnisse von geplanten Kaiserschnittentbindungen wurden mit den Ergebnissen von beabsichtigten vaginalen Entbindungen in Beckenendlage verglichen. Letztere Gruppe wurde weiter in erfolgreiche und erfolglose Versuche einer vaginalen Entbindung in Beckenendlage unterteilt.

Ergebnisse
Von der Gesamtgruppe aller Entbindungen waren 3,6 % (3172) Einlingsgeburten in Beckenendlage nach der 36. Schwangerschaftswoche. Davon waren 2501 (78,8 %) geplante Kaiserschnittentbindungen, während in 671 Fällen (21,2 %) eine vaginale Beckenendlagengeburt beabsichtigt wurde. In der Gruppe der beabsichtigten vaginalen Beckenendlagengeburten hatten 524 (78 %) eine vaginale Entbindung, während 147 (22 %) einen sekundären Kaiserschnitt benötigten. Bei den mütterlichen Outcomes gab es signifikante Unterschiede bezüglich Blutverlust ($p < 0{,}001$) und Krankenhausaufenthalt ($p < 0{,}001$), wobei die Gruppe der vaginalen Beckenendlagengeburten einen geringeren Blutverlust und einen kürzeren Krankenhausaufenthalt aufwies. Allerdings wurden neonatale Interventionen, darunter Masken-Beutel-Beatmung und Wiederbelebung, signifikant häufiger in der Gruppe der vaginalen Beckenendlagengeburten benötigt ($p < 0{,}001$), und kurzfristige neonatale Morbiditäten wie z. B. neonatale Infektionen ($p < 0{,}001$), transiente Tachypnoe ($p = 0{,}002$) und hypoxisch-ischämische Enzephalopathie ($p = 0{,}008$) waren höher.

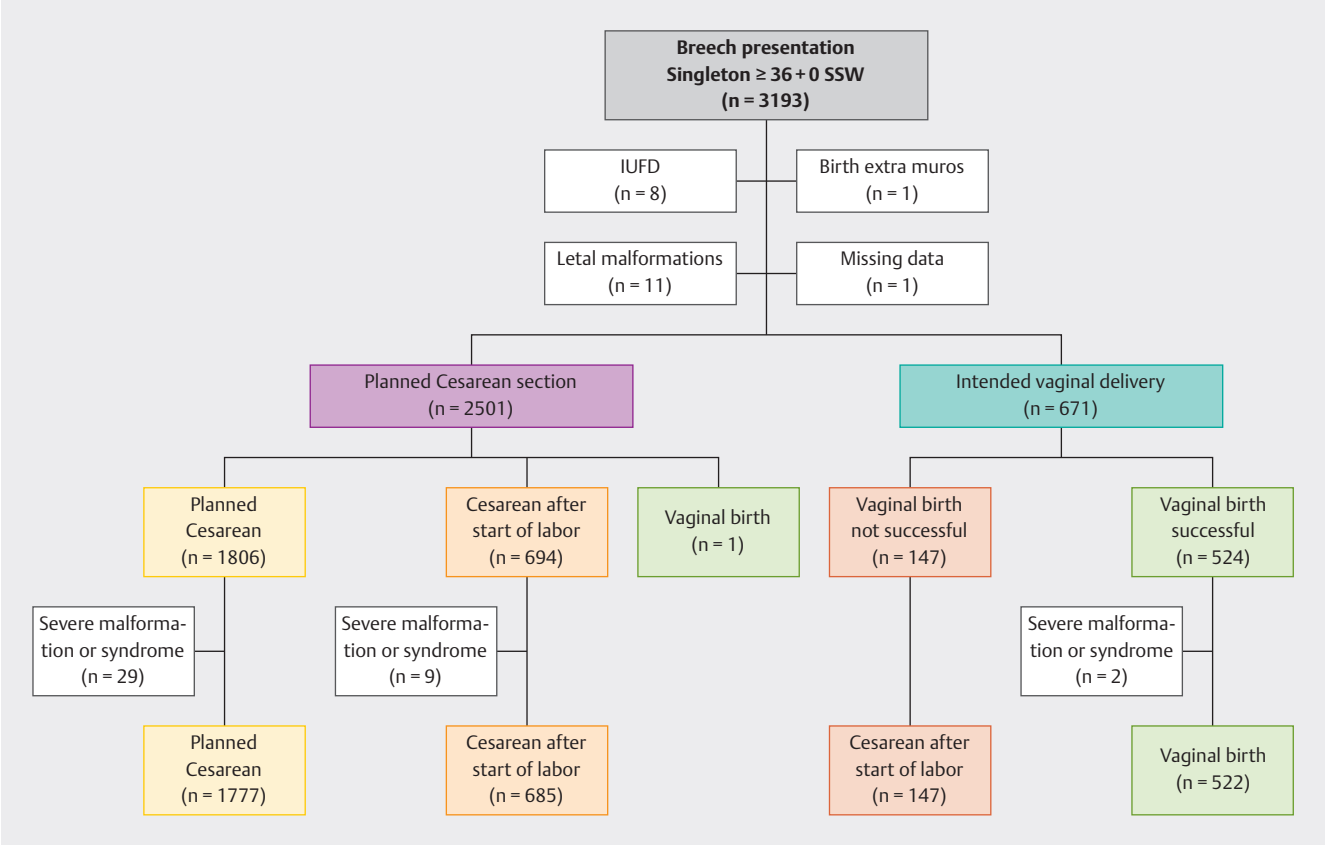
Schlussfolgerung
Diese Ergebnisse wiesen auf eine Zunahme geplanter vaginaler Beckenendlagengeburten mit einer hohen Rate erfolgreicher vaginaler Entbindungen hin. Die vaginale Beckenendlagengeburt war mit geringeren mütterlichen Komplikationen, aber einer höheren kurzfristigen neonatalen Morbidität verbunden. Wenn eine vaginale Beckenendlagengeburt in Erwägung gezogen wird, unterstreichen diese Ergebnisse die Bedeutung einer individualisierten Beratung sowie der Anwesenheit eines erfahrenen Geburtshelfers, um die Mutter bei der informierten Entscheidung zu unterstützen und das Geburts-Outcome zu optimieren.

Abbreviations

BMI	Body Mass Index
CS	Cesarean Section
CTG	Cardiotocography
ECV	External Cephalic Version
FGR	Fetal Growth Restriction
GA	Gestational Age
HIE	Hypoxic-ischemic Encephalopathy
ICU	Intensive Care Unit
LP	Lateral Position
NICU	Neonatal Intensive Care Unit
PROM	Premature Rupture of Membranes
RCOG	Royal College of Obstetricians and Gynecologists
SP	Supine Position
TBT	Term Breech Trial
UP	Upright Position
VBB	Vaginal Breech Birth

Introduction

Up to 4 % of term pregnancies present in breech presentation [1]. Despite this, there is still no consensus on the optimal mode of delivery [2, 3]. Until the 1990 s, vaginal breech birth (VBB) was widely regarded as a safe option [4]. However, the Term Breech Trial (TBT), published in 2000, marked a significant shift in obstetric practice. Hannah et al. reported improved short-term neonatal outcomes with planned cesarean section (CS) for term breech deliveries [5]. The TBT, however, faced criticism for its methodology and applicability, resulting in variations in national guidelines [6, 7, 8]. In Europe, initiatives such as PREMODA in France [5], OptiBreech in the United Kingdom [6] and FRABAT in Germany [7], have aimed to reestablish VBB as a viable option in appropriately trained settings. In Germany, current guidelines recommend counseling women with breech babies on both CS and VBB in perinatal centers capable of offering both options [8]. In our center, VBB rates have increased since the TBT. Within the last decade, ap-



▶ **Fig. 1** Flow chart of intended and actual birth mode at LMU Klinikum 2001–2021. In total, data of 3193 singletons in breech presentation with a GA ≥ 36 + 0 weeks were included. The groups of intended CS were subdivided in CS before and after onset of labor and intended VBB were subdivided in successful and unsuccessful VBB.

proximately 40 % of breech deliveries were VBB attempts. This study retrospectively analyzed VBB data to enhance counseling for future patients.

Material and Methods

We conducted a retrospective, single-center cohort study from January 2001 to December 2021. Ethical approval was obtained from the Ethics Committee of the University of Munich (Project Number 22–065) on August 16 th, 2022. The study was conducted in accordance with the Declaration of Helsinki.

Data were retrieved from the database of a German Tertiary Perinatal Center with two delivery units and approximately 3800 births annually. After excluding cases with lethal malformations, intrauterine death, and births occurring before transfer to the hospital, we analyzed all singleton breech presentations beyond 36 weeks of gestation. Mode of delivery was discussed with all pregnant women presenting with a fetus in breech position prior to the onset of labor. Apart from maternal preference for a birth mode, contraindications like fetal growth restriction (FGR) with a difference in abdominal circumference being smaller than the head circumference of more than 3 cm or fetal anomalies were checked. In our unit, there was no clear suggestion for MRI measurement of the maternal pelvis in nulliparous women. It was up to the counseling obstetrician to suggest MRI pelvimetry. Expert counseling included a detailed discussion with the patient about reasons to follow or to abandon the vaginal birth way. Maternal unfavorable conditions as previous CS, pregnancy-related or preexisting diabetes, hypertensive pregnancy disorders, and uterine abnormalities were discussed with the patient but did not automatically lead to a planned CS. The presence of an experienced obstetrician and of a pediatrician at birth was mandatory. If this was not the case, a cesarean section was performed.

All patients with a fetus in breech presentation were offered an external cephalic version (ECV), however participation in ECV was not mandatory.

Outcomes

The primary outcome was the rate of successful VBB. Secondary outcomes included both maternal and neonatal outcomes. Maternal outcomes encompassed blood loss, length of hospital stay, birth-related trauma, re-laparotomy due to bleeding, hysterectomy, postpartum ICU admission, wound healing disorders, and complications such as endometritis, deep vein thrombosis, or maternal death. Neonatal outcomes included measures of neonatal morbidity, such as infections, transient tachypnea, hypoxic-ischemic encephalopathy (HIE), hypoglycemia, hypothermia, APGAR scores, umbilical cord pH levels, birth trauma, and neonatal death.

▶**Table 1** Maternal characteristics regarding the intended birth mode divided in planned CS and intended VBB.

Maternal characteristics		Intended birth mode				
		Planned CS		Intended VBB		
		n = 2501	(%)	n = 671	(%)	Sig.
Age						0.010
	≤ 21 years	49	(2.0)	5	(0.7)	
	22–34 years	1548	(61.9)	450	(67.1)	
	≥ 35 years	904	(36.1)	216	(32.2)	
BMI before pregnancy						0.007
	BMI < 30 kg/m²	2249	(89.9)	629	(93.7)	
	BMI ≥ 30 kg/m²	193	(7.7)	32	(4.8)	
	Unknown	59	(2.4)	10	(1.5)	
Parity						0.012
	1 (this birth)	1858	(74.3)	461	(68.7)	
	2 (one previous birth)	482	(19.3)	153	(22.8)	
	> 2	161	(6.4)	57	(8.5)	
Condition after CS		367	(14.7)	8	(1.2)	< 0.001
Status post exclusively vaginal births		277	(11.1)	202	(30.1)	< 0.001
Diabetes mellitus/Gestational diabetes		186	(7.4)	29	(4.3)	0.004
Hypertensive pregnancy disorders		69	(2.8)	9	(1.3)	0.035
Uterus anomaly		201	(8.0)	33	(4.9)	0.006

Data sets included maternal baseline characteristics and birth outcomes, categorized by mode of delivery (successful VBB, unplanned CS after failed VBB, planned CS, secondary CS due to onset of labor before planned CS). Data was extracted from databases, with additional information from the paper-based birth register and the hospital's internal SAP clinical system.

Statistical analysis

Descriptive statistics were presented using frequency tables, and medians with interquartile ranges were used for metric and ordinal data. Pearson's Chi-square test and Fisher's exact test were employed to compare categorical variables across intended birth modes. Ordinal and metric data were analyzed using the Wilcoxon-Mann-Whitney U test. An alpha error of 5% was considered, with $p < 0.05$ deemed statistically significant and $p < 0.001$ considered highly significant. A multivariable logistic regression analysis was performed to identify factors associated with successful vaginal delivery. The Kruskal-Wallis test was used to compare three or more independent groups on a continuous or ordinal dependent variable. All analyses were conducted using IBM SPSS Statistics version 29.

Results

Between January 2001 and December 2021, the LMU Perinatal Center recorded 80778 births. Among these, 3172 (3.6%) were singleton breech presentations at or beyond 36 weeks gestation, meeting our inclusion criteria. Of these, 2501 (78.8%) were planned CS, and 671 (21.2%) were intended VBB. Among the intended VBBs, 524 babies (78%) were delivered vaginally, while 147 women (22%) required unplanned CS due to factors such as pathological CTG, prolonged labor, arrest of labor, maternal exhaustion, or maternal request. These data are presented in ▶**Fig. 1**.

We categorized the CS group into planned cesarean deliveries and those performed after labor onset but previously planned. The planned VBB group was further divided into those who successfully delivered vaginally and those who required a secondary CS.

Over the 21-year period, 37 obstetricians managed vaginal breech births at our center. Notably, 80.5% of successful VBBs (422 out of 542) were led by ten experts, each with over ten successful VBBs during this period, with individual experience ranging from 10 to 121 successful VBBs. Obstetricians trained in VBB provided nearly continuous coverage, ensuring availability almost 24 hours a day, 7 days a week.

▶**Table 2** Maternal characteristics regarding the intended birth mode divided in planned CS and intended VBB.

		Birth mode							
		Planned CS		Secondary CS after spontaneous onset of labor		Secondary CS after an unsuccessful attempted VBB		Successful VBB	
		n = 1 806	(%)	n = 694	(%)	n = 147	(%)	n = 525	(%)
Maternal age	≤ 21 years	34	(1.9)	15	(2.2)	0	(0.0)	5	(1.0)
	22–34 years	1 115	(61.7)	432	(62.2)	91	(61.9)	360	(68.6)
	≥ 35 years	657	(36.4)	247	(35.6)	56	(38.1)	160	(30.5)
BMI before pregnancy	BMI < 30 kg/m²	1 619	(89.6)	629	(90.6)	142	(96.6)	488	(93.0)
	BMI ≥ 30 kg/m²	157	(8.7)	36	(5.2)	4	(2.7)	28	(5.3)
	Unknown	30	(1.7)	29	(4.2)	1	(0.7)	9	(1.7)
Parity	1 (this birth)	1 339	(74.1)	519	(74.8)	128	(87.1)	333	(63.4)
	2 (one previous birth)	348	(19.3)	133	(19.2)	16	(10.9)	138	(26.3)
	> 2	119	(6.6)	42	(6.1)	3	(2.0)	54	(10.3)
Condition after CS		281	(15.6)	86	(12.4)	3	(2.0)	5	(1.0)
Status post exclusively vaginal births		186	(10.3)	90	(13.0)	16	(10.9)	187	(35.6)
Diabetes mellitus/Gestational diabetes		143	(7.9)	43	(6.2)	7	(4.8)	22	(4.2)
Hypertensive pregnancy disorders		59	(3.3)	10	(1.4)	5	(3.4)	4	(0.8)
Uterus anomaly		148	(8.2)	53	(7.6)	7	(4.8)	26	(5.0)

Maternal characteristics

In this analysis, we compared the 2501 planned CS cases with the 671 intended VBB cases. Significant differences were observed in maternal age ($p = 0.01$), with a lower pre-pregnancy BMI in the intended VBB group ($p = 0.007$). The VBB group also had a higher proportion of multiparous women ($p = 0.012$), with a highly significant p-value for those with a history of exclusively vaginal births ($p < 0.001$). Previous CS was significantly more common in the planned CS group ($p < 0.001$). Regarding maternal unfavorable conditions, a significantly higher rate of either pregnancy-related or preexisting diabetes ($p = 0.04$), hypertensive pregnancy disorders ($p = 0.035$), and uterine anomalies ($p = 0.06$) was detected in the planned CS group (see ▶ **Table 1** and ▶ **Table 2**).

Maternal outcomes

Maternal outcomes showed highly significant differences in blood loss ($p < 0.001$) and hospital stay ($p < 0.001$), as well as significant differences in elevated blood loss > 1000 ml ($p = 0.004$) and > 1500 ml ($p = 0.012$), and postpartum hemoglobin levels ($p = 0.016$) in the planned CS group. No significant differences were observed regarding birth-related trauma, re-laparotomy due to bleeding, hysterectomy, postpartum ICU stay, wound healing disorders, or complications such as endometritis, deep vein thrombosis, ileus, or postpartum depression. No maternal deaths occurred in either group (see ▶ **Table 3**).

▶**Table 3** Maternal Outcome regarding intended birth mode divided in planned CS and intended VBB.

Maternal Outcome		Intended birth mode					
		Planned CS		Intended VBB			
		n = 2 501	(%)	n = 671	(%)	Odds Ratio (95 %-KI)	Sig.
Blood loss in ml	Median (IQR)	500 (200)		300 (200)			< 0.001
Elevated blood loss	> 1000 ml	63	(2.5)	31	(4.6)	1.87 (1.21–2.90)	0.004
	> 1500 ml[E]	16	(0.6)	11	(1.6)	2.59 (1.19–5.60)	0.012
Transfusion of ECs[E]		11	(0.4)	5	(0.7)	1.70 (0.59–4.91)	0.355

▶Table 3 continued

Maternal Outcome		Intended birth mode					
		Planned CS		Intended VBB			
		n = 2501	(%)	n = 671	(%)	Odds Ratio (95%-KI)	Sig.
Hb level postpartum	Median (IQR)	10.9 (1.6)		11.0 (2.1)			0.016
	≥ 10 g/dl	1961	(78.4)	469	(69.9)		
	8 g/dl > and < 10 g/dl	473	(18.9)	133	(19.8)		
	6 g/dl < and ≤ 8 g/dl	48	(1.9)	26	(3.9)		
	≤ 6 g/dl[E]	6	(0.2)	3	(0.4)	1.98 (0.49–7.92)	0.398
	Unknown	13	(0.5)	40	(6.0)		
Birth-related trauma[E]		8	(0.3)	0	(0.0)	–	0.216
Definition of trauma	Urinary bladder lesion intraoperative	6	(0.2)	0	(0.0)		
	Uterus perforation	1	(0.0)	0	(0.0)		
	Electrical burn intraoperative	1	(0.0)	0	(0.0)		
Cervical laceration[E]		0	(0.0)	1	(0.1)	–	–
Re-laparotomy due to bleeding[E]		7	(0.3)	1	(0.1)	0.53 (0.07–4.33)	1.000
Hysterectomy[E]		2	(0.1)	0	(0.0)	–	–
Postpartum transfer to intensive care unit (ICU)		25	(1.0)	3	(0.4)	0.45 (0.13–1.48)	0.174
Severe preeclampsia postpartum with ICU stay		15	(0.6)	1	(0.2)		0.219
Postpartum transfer to ICU (except severe preeclampsia)[E]		10	(0.4)	2	(0.3)	0.74 (0.16–3.39)	1.000
Impaired wound healing		30	(1.2)	11	(1.6)	1.37 (0.68–2.75)	0.370
Definition of wound healing	Wound infection[E]	12	(0.5)	1	(0.1)		
	Hematoma with evacuation[E]	4	(0.2)	2	(0.3)		
	Wound dehiscence with secondary closure[E]	2	(0.1)	2	(0.3)		
	Abscess[E]	1	(0.0)	0	(0.0)		
	Others	11	(0.4)	6	(0.9)		
Sepsis[E]		1	(0.0)	0	(0.0)	–	–
General complications during the postpartum hospital stay		100	(4.0)	22	(3.3)	0.81 (0.51–1.30)	0.385
Definition of general complications	Endometritis/Endomyometritis[E]	4	(0.2)	0	(0.0)		
	Deep vein thrombosis (DVT)[E]	2	(0.1)	0	(0.0)		
	Ileus[E]	3	(0.1)	1	(0.1)		
	Postpartum depression[E]	4	(0.2)	0	(0.0)		
	Others	87	(3.5)	21	(3.1)		
Postpartum hospital stay in days	Median (IQR)	5 (2)		3 (2)			< 0.001
Maternal death[E]		0	(0.0)	0	(0.0)		
Composite variable 'postpartum maternal mortality and severe morbidity'.‡		65	(2.6)	19	(2.8)	1.09 (0.65–1.83)	0.752

[E] Included criterion for composite variable 'postpartum maternal mortality and severe morbidity'.
‡ Cases with severe preeclampsia with ICU stay were excluded.

▶**Table 4** Birth characteristics: Parameters divided between the intended birth mode (CS versus intended VBB).

Birth characteristics		Intended birth mode				
		Planned CS		Intended VBB		
		n = 2501	(%)	n = 671	(%)	Sig.
Performance of an external cephalic version (ECV)		822	(32.9)	492	(73.3)	< 0.001
Spontaneous onset of labor		364	(14.6)	668	(99.6)	< 0.001
Anesthesia during birth						< 0.001
	None	0	(0.0)	205	(30.6)	
	Regional anesthesia	2364	(94.5)	436	(65.0)	
	Intubation	137	(5.5)	30	(4.5)	
CTG abnormalities						< 0.001
	Suspicious	34	(1.4)	68	(10.1)	
	Pathologic	21	(0.8)	79	(11.8)	
	Pathologic – terminal bradycardia	6	(0.2)	27	(4.0)	
Relative indication for CS						0.007
	Suspicion for relative disproportion	44	(1.8)	15	(2.2)	
	Unfavorable fetal factors	38	(1.5)	14	(2.1)	
	Footling breech presentation	11	(0.4)	8	(1.2)	
	Cord presentation	11	(0.4)	0	(0.0)	
	Presenting hand	0	(0.0)	2	(0.3)	
"Absolute" indications for CS						< 0.001
	Terminal bradycardia	0	(0.0)	2	(0.3)	
	Cord prolapse	5	(0.2)	8	(1.2)	
	Footling presentation	3	(0.1)	6	(0.9)	
	Placental abruption	8	(0.3)	4	(0.6)	
	Uterine rupture	13	(0.5)	1	(0.1)	
	Amniotic infection syndrome	3	(0.1)	4	(0.6)	
	Others	0	(0.0)	1	(0.1)	
Emergency CS		10	(0.4)	16	(2.4)	< 0.001
Difficult fetal extraction		52	(2.1)	40	(6.0)	< 0.001
Umbilical cord entanglement		103	(4.1)	62	(9.2)	< 0.001
Abnormal placenta position	Placenta previa	16	(0.6)	0	(0.0)	
Retained placenta		195	(7.8)	61	(9.1)	0.277

Birth parameters

We analyzed birth parameters across groups (see ▶**Table 4** and ▶**Table 5**). A significant difference was found in the use of external cephalic version (ECV) for the VBB group ($p < 0.001$). Spontaneous labor onset was more common in the VBB group ($p < 0.001$). The VBB group had a higher rate of CTG abnormalities ($p < 0.001$) and a lower rate of anesthesia ($p < 0.001$), since CS always require anesthesia. The emergency CS rate was significantly higher in the VBB group ($p < 0.001$). In unplanned emergency CS, difficult fetal extraction was mentioned in some cases. The term "difficult fetal extraction" was used when the obstetrician indicated in the report that delivering the baby in a breech position was challenging. This applied either during a cesarean section (CS) or a vaginal breech birth (VBB) when additional maneuvers were required to facilitate the baby's delivery. Cord entanglement was defined as the presence of the umbilical cord wrapped around the fetus' neck, body, or extremities.

There were no significant differences in spontaneous labor onset between successful (100%) and unsuccessful (98%) VBBs (see ▶**Table 5**).

Fetal characteristics

Over 80% of babies in both groups had frank or complete breech presentations. Amniotic fluid levels were mostly normal in both

▶**Table 5** Birth characteristics. Parameters divided between the birth mode CS (planned CS and CS after spontaneous onset of labor) and intended VBB (successful VBB versus secondary CS after intended VBB).

Birth characteristics		Birth mode							
		Planned CS		Secondary CS after spontaneous onset of labor		Secondary CS after an unsuccessful attempted VBB		Successful VBB	
		n = 1 806	(%)	n = 694	(%)	n = 147	(%)	n = 525	(%)
Performance of an external cephalic version (ECV)		571	(31.6)	251	(36.2)	119	(81.0)	373	(71.1)
Spontaneous onset of labor		0	(0.0)	363	(52.3)	144	(98.0)	525	(100.0)
Anesthesia during labor	None	0	(0.0)	0	(0.0)	0	(0.0)	206	(39.2)
	Regional anesthesia	1 726	(95.6)	637	(91.8)	117	(79.6)	319	(60.8)
	Intubation	80	(4.4)	57	(8.2)	30	(20.4)	0	(0.0)
CTG abnormalities	Suspicious	21	(1.2)	13	(1.9)	20	(13.6)	48	(9.1)
	Pathologic	13	(0.7)	8	(1.2)	37	(25.2)	42	(8.0)
	Pathologic – terminal bradycardia	2	(0.1)	4	(0.6)	14	(9.5)	13	(2.5)
Relative indications for CS	Suspicion for relative disproportion	37	(2.0)	7	(1.0)	11	(7.5)	4	(0.8)
	Unfavorable fetal factors	18	(1.0)	20	(2.9)	12	(8.2)	2	(0.4)
	Footling breech presentation	1	(0.1)	10	(1.4)	8	(5.4)	0	(0.0)
	Cord presentation	5	(0.3)	6	(0.9)	0	(0.0)	0	(0.0)
	Presenting Hand	0	(0.0)	0	(0.0)	2	(1.4)	0	(0.0)
"Absolute" indications for CS	Terminal bradycardia	0	(0.0)	0	(0.0)	1	(0.7)	1	(0.2)
	Cord prolapse	0	(0.0)	5	(0.7)	8	(5.4)	0	(0.0)
	Footling presentation	0	(0.0)	2	(0.3)	4	(2.7)	3	(0.6)
	Placental abruption	3	(0.2)	5	(0.7)	1	(0.7)	3	(0.6)
	Uterine rupture	10	(0.6)	3	(0.4)	1	(0.7)	0	(0.0)
	Amniotic infection syndrome	0	(0.0)	3	(0.4)	2	(1.4)	2	(0.4)
	Others	0	(0.0)	0	(0.0)	1	(0.7)	0	(0.0)
Emergency CS		2	(0.1)	8	(1.2)	16	(10.9)	0	(0.0)
Difficult fetal development		36	(2.0)	16	(2.3)	13	(8.8)	27	(5.1)
Umbilical cord entanglement		76	(4.2)	27	(3.9)	17	(11.6)	45	(8.6)
Abnormal placenta position	Placenta previa	14	(0.8)	2	(0.3)	0	(0.0)	0	(0.0)
Retained placenta		127	(7.0)	68	(9.8)	18	(12.2)	43	(8.2)

groups. A significant difference in gestational age ($p < 0.01$) was observed, with planned CS often performed before 39 weeks, while many VBBs occurred after the due date. There were no significant differences in sex or birth weight. However, more babies in the VBB group had weights below the 10 th percentile, and fewer had weights above the 90 th percentile ($p = 0.002$).

In neonatal care, the VBB group had higher rates of bag-mask ventilation and resuscitation ($p < 0.001$). Oxygen therapy was more common in this group ($p = 0.015$), but intubation rates did not differ significantly ($p = 0.184$).

Neonatal morbidity was higher in the VBB group for infections ($p < 0.001$), transient tachypnea ($p = 0.002$), and hypoxic-ischemic encephalopathy (HIE) ($p = 0.008$). No significant differences were found for hypoglycemia ($p = 0.075$), hypothermia ($p = 0.672$), or hyperbilirubinemia ($p = 0.016$).

APGAR scores at 1, 5, and 10 minutes were lower in the VBB group ($p < 0.001$). The 5-minute APGAR score ($p < 0.001$) and um-

bilical cord pH also differed significantly, with a median of 7.32 in the CS group and 7.26 in the VBB group. The VBB group showed higher rates of umbilical cord pH < 7.1 and < 7.0, as well as a base excess ≥ 15 mmol/L. Fetal birth trauma was more common in the VBB group ($p < 0.001$). Fetal birth trauma included fracture of bones, e.g. clavicle, humerus, trochanter, skull, lesion of plexus brachialis, facial nerve palsy, injury of M. sternocleidomastoideus, incision injury during CS, hematoma, or injury to the externa genitalia.

Transfers to the NICU after vaginal birth were also more frequent in the VBB group ($p < 0.001$). One neonatal death occurred in the VBB group, and none in the CS group. The composite variable for fetal mortality and severe morbidity was significantly higher in the VBB group ($p < 0.001$) (see ▶ **Table 5**).

Four cases of HIE occurred in the intended VBB group, all associated with CTG abnormalities. In each case, experienced obstetricians with more than 10 VBB were present. In one case, an emergency CS was performed during the first stage of labor due to non-reassuring fetal heart rate patterns. In the other three cases, vaginal delivery was achieved after onset of CTG abnormalities in the second stage of labor. See ▶ **Table 6** and ▶ **Table 7**.

The cases are detailed below.

Case #1: A primiparous woman at 41 + 5 weeks GA presented with spontaneous labor onset and received epidural anesthesia. She had a prolonged second stage of labor with pathological CTG. The baby was delivered following Bickenbach and Veit-Smellie maneuvers. The umbilical cord pH was 7.16, BE was − 10, and APGAR scores were 1, 6, and 7 at 1, 5, and 10 minutes, respectively. Birth weight was 3685 g (42 nd percentile). The neonate was transferred to the NICU, where HIE was diagnosed, and hypothermia treatment was initiated. The baby was discharged after 12 days. Long-term follow-up, with the last examination at 2 years and 10 months of age, showed normal development.

Case #2: A 40 + 6-week GA, Gravida 2, Para 1 woman presented with spontaneous labor onset and received an epidural. During the second stage of labor, CTG showed terminal bradycardia. The neonate was delivered with difficult fetal extraction, including arm and head delivery. The umbilical cord pH was 6.92, BE was − 16, and

▶**Table 6** Fetal characteristics divided between intended birth mode CS versus VBB.

Fetal characteristics		**Intended birth mode**				
		Planned CS		**Intended VBB**		
		n = 2501	**(%)**	**n = 671**	**(%)**	**Sig.**
Variant of breech presentation						
	Frank breech position	1924	(76.9)	482	(71.8)	
	Complete breech position	301	(12.0)	137	(20.4)	
	Footling breech position	53	(2.1)	41	(6.1)	
	Knee breech position	1	(0.0)	1	(0.1)	
	Breech not specifically defined	222	(8.9)	10	(1.5)	
Amount of amniotic fluid						0.290
	Oligohydramnios	159	(6.4)	41	(6.1)	
	Polyhydramnios	33	(1.3)	4	(0.6)	
	Normal	2309	(92.3)	626	(93.3)	
Abnormal fetal intrauterine condition	Placenta insufficiency/abnormal Doppler	63	(2.5)	9	(1.3)	0.069
Gestational week						< 0.001
	36 + 0–36 + 6	205	(8.2)	42	(6.3)	
	37 + 0–37 + 6	444	(17.8)	56	(8.3)	
	38 + 0–38 + 6	1070	(42.8)	129	(19.2)	
	39 + 0–39 + 6	659	(26.3)	197	(29.4)	
	40 + 0–40 + 6	106	(4.2)	165	(24.6)	
	≥ 41 + 0	17	(0.7)	82	(12.2)	
Birth weight						0.102
	< 2500 g	173	(6.9)	28	(4.2)	
	2500 g–2999 g	720	(28.8)	194	(28.9)	
	3000 g–3799 g	1445	(57.8)	401	(59.8)	
	3800 g–3999 g	98	(3.9)	32	(4.8)	
	≥ 4000 g	65	(2.6)	16	(2.4)	

▶Table 6 continued

Fetal characteristics		Intended birth mode				
		Planned CS		Intended VBB		
		n = 2501	(%)	n = 671	(%)	Sig.
Birth weight percentiles						0.002
	< 10 th Percentile	339	(13.6)	116	(17.3)	
	10 th–90 th Percentile	2073	(82.9)	545	(81.2)	
	> 90 th Percentile	89	(3.6)	10	(1.5)	
Malformation of the newborn		448	(17.9)	138	(20.6)	0.116
Severe malformation or syndrome of the newborn		38	(1.5)	2	(0.3)	0.012
Neonatal care in the delivery room	Bag-mask ventilation	415	(16.6)	173	(25.8)	< 0.001
	Oxygen therapy	447	(17.9)	148	(22.1)	0.015
	Intubation	17	(0.7)	8	(1.2)	0.184
	Reanimation	0	(0.0)	8	(1.2)	< 0.001
Neonatal morbidity	Transient tachypnea of the newborn (TTN)	318	(12.7)	114	(17.0)	0.002
	Hypoxic-ischemic encephalopathy (HIE)	1	(0.0)	4	(0.6)	0.008
	Neonatal infection	151	(6.0)	84	(12.5)	< 0.001
	Hypoglycemia	333	(13.3)	72	(10.7)	0.075
	Hypothermia	260	(10.4)	66	(9.8)	0.672
	Hyperbilirubinemia	181	(7.2)	31	(4.6)	0.016
Feeding issues in the newborn		486	(19.4)	118	(17.6)	0.279
APGAR score after 1 minute	Median (IQR)	9 (1)		8 (2)		< 0.001
After 5 minutes	Median (IQR)	10 (0)		10 (1)		< 0.001
After 10 minutes	Median (IQR)	10 (0)		10 (0)		< 0.001
5-minutes APGAR score	< 7	13	(0.5)	16	(2.4)	< 0.001
	< 4[D]	0	(0.0)	3	(0.4)	0.01
Umbilical cord pH	Median (IQR)	7.32 (0.07)		7.26 (0.13)		< 0.001
	< 7.1	13	(0.5)	47	(7.0)	< 0.001
	< 7.0	2	(0.1)	11	(1.6)	< 0.001
	unknown	13	(0.5)	1	(0.1)	
Base excess	≥ 15 mmol/L[D]	8	(0.3)	19	(2.8)	< 0.001
	unknown	33	(1.3)	3	(0.5)	
Fetal birth trauma		26	(1.0)	37	(5.5)	< 0.001
Type of birth trauma	Fracture of the clavicle	1	(0.0)	4	(0.6)	
	Fracture of the humerus	0	(0.0)	1	(0.1)	
	Fracture of the trochanter	0	(0.0)	1	(0.1)	
	Skull fracture[D]	0	(0.0)	1	(0.1)	
	Lesion of Plexus brachialis[D]	2	(0.1)	9	(1.3)	
	Facial nerve palsy[D]	4	(0.2)	0	(0.0)	
	Injury of M. sternocleidomastoideus	0	(0.0)	1	(0.1)	
	Incision injury during CS	16	(0.6)	2	(0.3)	
	Hematoma	0	(0.0)	6	(0.9)	
	Injury to the external genitalia	0	(0.0)	10	(1.5)	
	Birth trauma without detailed information	3	(0.1)	3	(0.4)	

▶**Table 6** continued

Fetal characteristics		Intended birth mode				
		Planned CS		Intended VBB		
		n = 2501	(%)	n = 671	(%)	Sig.
Transfer to NICU		119	(4.8)	54	(8.0)	< 0.001
Length of stay in the NICU	≤ 4 days	60	(2.4)	42	(6.3)	
	> 4 days	50	(2.0)	12	(1.8)	
	unknown	9	(0.4)	0	(0.0)	
Invasive ventilation of the newborn (malformations excluded)		7	(0.3)	7	(1.0)	0.017
Intubation > 24 h (malformations excluded)		6	(0.2)	6	(0.9)	0.027
Non-invasive ventilation of the newborn (malformations excluded)		16	(0.7)	17	(2.5)	< 0.001
Other interventions in the NICU (malformations excluded)	Thoracic drainage	2	(0.1)	2	(0.3)	
	Hypothermia treatment	0	(0.0)	4	(0.6)	
	Blood transfusion/Exchange transfusion	2	(0.1)	0	(0.0)	
	Unknown	9	(0.4)	0	(0.0)	
Reason for transfer to the NICU	transient tachypnea of the newborn (TTN)	31	(1.2)	23	(3.4)	
	transient tachypnea of the newborn (TTN) + (suspicion of) neonatal infection	14	(0.6)	7	(1.0)	
	(suspicion of) neonatal infection	5	(0.2)	1	(0.1)	
	Hypoxia/Acidosis	0	(0.0)	14	(2.1)	
	Birth trauma	0	(0.0)	3	(0.4)	
	Hypoglycemia	6	(0.2)	2	(0.3)	
	Hypothermia	0	(0.0)	0	(0.0)	
	Prematurity/low birth weight	5	(0.2)	1	(0.1)	
	Hyperbilirubinemia	1	(0.0)	0	(0.0)	
	Hearth rhythm disorder	4	(0.2)	0	(0.0)	
	Hematologic cause	5	(0.2)	0	(0.0)	
	Withdrawal symptoms due to maternal drug or medication use	3	(0.1)	0	(0.0)	
	Cramps	1	(0.0)	0	(0.0)	
	Maternal risk factors	1	(0.0)	0	(0.0)	
	Others	5	(0.2)	1	(0.1)	
	Fetal malformations	38	(1.5)	2	(0.3)	
Transfer to NICU due to severe malformation or syndrome		38	(1.5)	2	(0.3)	0.012
Prenatal death		0	(0.0)	0	(0.0)	–
Postnatal death		0	(0.0)	1	(0.1)	–
composite variable 'fetal mortality and severe morbidity'‡		40	(1.6)	35	(5.2)	< 0.001

[D] Included criterion for the composite variable 'fetal mortality and severe morbidity'.
‡ Cases with severe malformation or syndrome were excluded.

▶**Table 7** Fetal characteristics divided between the birth mode CS (planned CS and CS after spontaneous onset of labor) and intended VBB (successful VBB versus secondary CS after intended VBB).

		Birth mode							
		Planned CS		Secondary CS after spontaneous onset of labor		Secondary CS after an unsuccessful attempted VBB		Successful VBB	
		n = 1 806	(%)	n = 694	(%)	n = 147	(%)	n = 525	(%)
Variant of breech presentation	Frank breech position	1 406	(77.9)	518	(74.6)	95	(64.6)	387	(73.7)
	Complete breech position	197	(10.9)	103	(14.9)	38	(25.9)	100	(19.0)
	Footling breech position	35	(1.9)	18	(2.6)	9	(6.1)	32	(6.1)
	Knee breech position	0	(0.0)	1	(0.1)	1	(0.7)	0	(0.0)
	Breech not specifically defined	168	(9.3)	54	(7.8)	4	(2.7)	6	(1.1)
Amount of amniotic fluid									
	Oligohydramnios	134	(7.4)	25	(3.6)	3	(2.0)	38	(7.2)
	Polyhydramnios	27	(1.5)	6	(0.9)	1	(0.7)	3	(0.6)
	Normal	1 646	(91.0)	662	(95.7)	143	(97.3)	484	(92.2)
Abnormal fetal intrauterine condition	Placenta insufficiency/ abnormal Doppler	55	(3.1)	8	(1.2)	2	(1.4)	7	(1.3)
Gestational week	36 + 0–36 + 6	75	(4.1)	130	(18.8)	9	(6.1)	33	(6.3)
	37 + 0–37 + 6	254	(14.0)	190	(27.5)	8	(5.4)	48	(9.1)
	38 + 0–38 + 6	853	(47.2)	217	(31.3)	23	(15.6)	106	(20.2)
	39 + 0–39 + 6	557	(30.8)	101	(14.6)	38	(25.9)	160	(30.5)
	40 + 0–40 + 6	62	(3.4)	44	(6.4)	38	(25.9)	127	(24.2)
	≥ 41 + 0	5	(0.3)	12	(1.7)	31	(21.1)	51	(9.7)
Birth weight	< 2500 g	124	(6.9)	49	(7.1)	4	(2.7)	24	(4.6)
	2500 g–2999 g	452	(25.0)	268	(38.7)	32	(21.8)	162	(30.9)
	3000 g–3799 g	1 095	(60.6)	349	(50.3)	93	(63.3)	309	(58.9)
	3800 g–3999 g	79	(4.4)	19	(2.7)	12	(8.2)	20	(3.8)
	≥ 4000 g	56	(3.1)	9	(1.3)	6	(4.1)	10	(1.9)
Birth weight percentiles	< 10 th Percentile	238	(13.2)	101	(14.6)	21	(14.3)	95	(18.1)
	10 th– 90 th Percentile	1 496	(82.8)	576	(83.0)	122	(83.0)	424	(80.8)
	> 90 th Percentile	72	(4.0)	17	(2.5)	4	(2.7)	6	(1.1)
Malformation of the newborn		306	(16.9)	142	(20.5)	46	(31.3)	92	(17.5)
Severe malformation or syndrome		29	(1.6)	9	(1.3)	0	(0.0)	2	(0.4)
Neonatal care in the delivery room	Bag-mask ventilation	305	(16.9)	109	(15.7)	46	(31.3)	128	(24.4)
	Oxygen therapy	325	(18.0)	122	(17.6)	44	(29.9)	104	(19.8)
	Intubation	12	(0.7)	5	(0.7)	2	(1.4)	6	(1.1)
	Reanimation	0	(0.0)	0	(0.0)	0	(0.0)	8	(1.5)
Neonatal morbidity	Transient tachypnea of the newborn (TTN)	222	(12.3)	96	(13.8)	27	(18.4)	87	(16.6)
	Hypoxic-ischemic encephalopathy (HIE)	1	(0.1)	0	(0.0)	1	(0.7)	3	(0.6)
	Neonatal infection	94	(5.2)	56	(8.1)	22	(15.0)	63	(12.0)
	Hypoglycemia	242	(13.4)	91	(13.1)	20	(13.6)	52	(9.9)
	Hypothermia	165	(9.1)	95	(13.7)	14	(9.5)	52	(9.9)
	Hyperbilirubinemia	129	(7.1)	52	(7.5)	2	(1.4)	29	(5.5)

▶**Table 7** continued

		Birth mode							
		Planned CS		Secondary CS after spontaneous onset of labor		Secondary CS after an unsuccessful attempted VBB		Successful VBB	
		n = 1 806	(%)	n = 694	(%)	n = 147	(%)	n = 525	(%)
Feeding issues in the newborn		326	(18.1)	160	(23.1)	43	(29.3)	75	(14.3)
APGAR score after 1 minute	Median (IQR)	9 (1)		9 (1)		8 (3)		8 (2)	
After 5 minutes	Median (IQR)	10 (0)		10 (0)		10 (1)		10 (1)	
After 10 minutes	Median (IQR)	10 (0)		10 (0)		10 (0)		10 (0)	
5 minutes APGAR score	< 7	11	(0.6)	2	(0.3)	5	(3.4)	11	(2.1)
	< 4[D]	0	(0.0)	0	(0.0)	0	(0.0)	3	(0.6)
Umbilical cord pH	Median (IQR)	7.32 (0.07)		7.32 (0.06)		7.29 (0.09)		7.25 (0.14)	
	< 7.1	12	(0.7)	1	(0.1)	6	(4.1)	41	(7.8)
	< 7.0	2	(0.1)	0	(0.0)	1	(0.7)	10	(1.9)
	Unknown	7	(0.4)	6	(0.9)	0	(0.0)	1	(0.2)
Base excess	≥ 15 mmol/L[D]	8	(0.4)	0	(0.0)	2	(1.4)	17	(3.2)
	Unknown	21	(1.2)	12	(1.7)	0	(0.0)	3	(0.6)
Fetal birth trauma		15	(0.8)	11	(1.6)	7	(4.8)	30	(5.7)
Type of birth trauma	Fracture of the clavicle	1	(0.1)	0	(0.0)	0	(0.0)	4	(0.8)
	Fracture of the humerus	0	(0.0)	0	(0.0)	0	(0.0)	1	(0.2)
	Fracture of the trochanter	0	(0.0)	0	(0.0)	1	(0.7)	0	(0.0)
	Skull fracture	0	(0.0)	0	(0.0)	0	(0.0)	1	(0.2)
	Lesion of Plexus brachialis[D]	1	(0.1)	1	(0.1)	0	(0.0)	9	(1.7)
	Facial nerve palsy[D]	1	(0.1)	3	(0.4)	0	(0.0)	0	(0.0)
	Injury of M. sternocleido-mastoideus	0	(0.0)	0	(0.0)	0	(0.0)	1	(0.2)
	Incision injury during CS	10	(0.6)	6	(0.9)	2	(1.4)	0	(0.0)
	Hematoma	0	(0.0)	0	(0.0)	0	(0.0)	6	(1.1)
	Injury to the external genitalia	0	(0.0)	0	(0.0)	3	(2.0)	7	(1.3)
	Birth trauma without detailed information	2	(0.1)	1	(0.1)	1	(0.7)	2	(0.4)
Transfer to NICU		83	(4.6)	36	(5.2)	13	(8.8)	41	(7.8)
Length of stay in the NICU	≤ 4 days	40	(2.2)	20	(2.9)	12	(8.2)	30	(5.7)
	> 4 days	37	(2.1)	13	(1.9)	1	(0.7)	11	(2.1)
Stay in the NICU > 4 days (malformations excluded)[D]		20	(1.1)	5	(0.7)	1	(0.7)	9	(1.7)
Invasive ventilation of the newborn (Malformations excluded)		5	(0.3)	2	(0.3)	0	(0.0)	7	(1.3)
Intubation > 24 h (Malformations excluded)[D]		4	(0.2)	2	(0.3)	0	(0.0)	6	(1.1)
Non-invasive ventilation of the newborn (Malformations excluded)		12	(0.7)	4	(0.6)	6	(4.1)	11	(2.1)

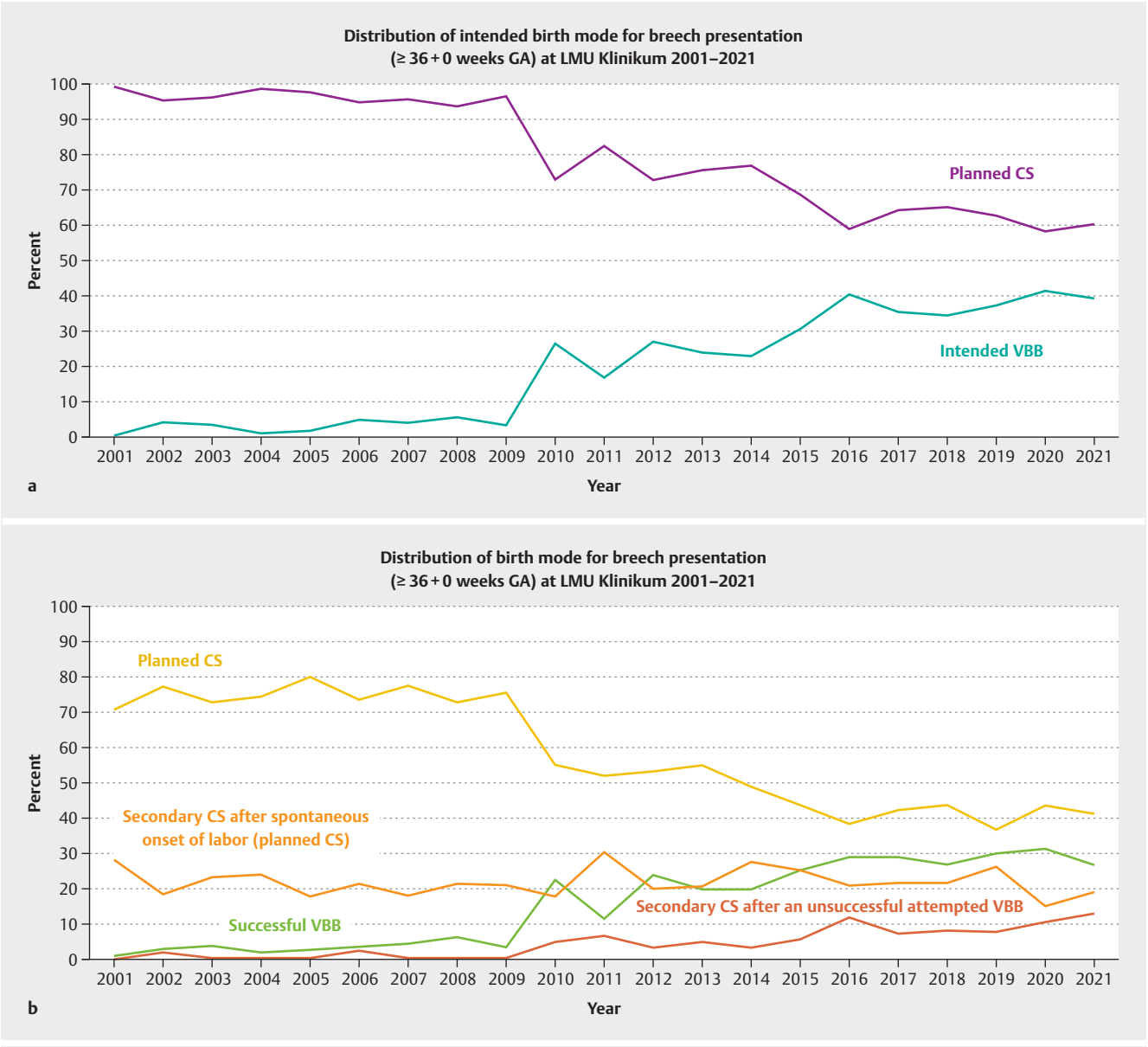
▶Table 7 continued

		Birth mode							
		Planned CS		Secondary CS after spontaneous onset of labor		Secondary CS after an unsuccessful attempted VBB		Successful VBB	
		n = 1806	(%)	n = 694	(%)	n = 147	(%)	n = 525	(%)
Other interventions in the NICU (Malformations excluded)	Thoracic drainage	1	(0.1)	1	(0.1)	0	(0.0)	2	(0.4)
	Hypothermia treatment	0	(0.0)	0	(0.0)	1	(0.7)	3	(0.6)
	Blood transfusion/ Exchange transfusion	2	(0.1)	0	(0.0)	0	(0.0)	0	(0.0)
Reason for transfer to the NICU	transient tachypnea of the newborn (TTN)	21	(0.6)	10	(1.5)	7	(4.8)	16	(3.0)
	transient tachypnea of the newborn (TTN) + (suspicion of) neonatal infection	9	(0.5)	5	(0.7)	3	(2.0)	4	(0.8)
	(Suspicion of) neonatal infection	2	(0.1)	3	(0.4)	0	(0.0)	1	(0.2)
	Hypoxia/Acidosis	0	(0.0)	0	(0.0)	1	(0.7)	13	(2.5)
	Birth trauma	0	(0.0)	0	(0.0)	1	(0.7)	2	(0.4)
	Hypoglycemia	3	(0.2)	3	(0.4)	0	(0.0)	2	(0.4)
	Hypothermia	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
	Prematurity/low birth weight	4	(0.2)	1	(0.1)	0	(0.0)	1	(0.2)
	Hyperbilirubinemia	0	(0.0)	1	(0.1)	0	(0.0)	0	(0.0)
	Hearth rhythm disorder	3	(0.2)	1	(0.1)	0	(0.0)	0	(0.0)
	Hematologic cause	4	(0.2)	1	(0.1)	0	(0.0)	0	(0.0)
	Withdrawal symptoms due to maternal drug or medication use	3	(0.2)	0	(0.0)	0	(0.0)	0	(0.0)
	Cramps	0	(0.0)	1	(0.1)	0	(0.0)	0	(0.0)
	Maternal risk factors	1	(0.1)	0	(0.0)	0	(0.0)	0	(0.0)
	Others	4	(0.2)	1	(0.1)	1	(0.7)	0	(0.0)
	Fetal malformations	29	(1.6)	9	(1.3)	0	(0.0)	2	(0.4)
Transfer to the NICU due to fetal malformations or syndromes		29	(1.6)	9	(1.3)	0	(0.0)	2	(0.4)
Prenatal death[D]		0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Postnatal death[D]		0	(0.0)	0	(0.0)	0	(0.0)	1	(0.2)
Composite variable 'fetal mortality and severe morbidity'‡		30	(1.7)	10	(1.5)	3	(2.0)	32	(6.1)

[D] Included criterion for the composite 'variable fetal mortality and severe morbidity'.
‡ Cases with severe malformation or syndrome were excluded.

APGAR scores were 2, 3, and 3. Birth weight was 3000 g (10 th percentile). Despite resuscitation and hypothermia treatment, the neonate developed severe bleeding, disseminated intravascular coagulation (DIC), seizures, and a burst-suppression pattern on EEG. Given the poor prognosis and ongoing severe bleeding, treatment was withdrawn, and the baby subsequently died.

Case #3: A nulliparous woman at 40 + 6 weeks GA presented with premature rupture of membranes (PROM) and developed endogenous contractions. She received epidural analgesia and oxyto-



▶ **Fig. 2** Distribution of intended birth mode for breeches in the time span examined in total (**a**), and distribution of the actual mode of delivery and the changes over time (**b**).

cin for contraction augmentation. The baby was delivered with maneuvers to facilitate arm (classic arm development) and head (Veit-Smellie) delivery. The umbilical cord pH was 7.22, BE was −8, and APGAR scores were 2, 3, and 7. Birth weight was 3000 g (10 th percentile). In addition to HIE, a brachial plexus injury was diagnosed. After four days of hypothermia treatment, the baby recovered, and a subsequent EEG showed normal findings. The neonate was discharged one week after birth. Long-term follow-up data are unavailable.

Case #4: A primigravida at 36 + 5 weeks GA, who had previously undergone pelvic MRI, presented with PROM and was induced with oxytocin. During the first stage of labor, at 8 cm dilation, CTG showed terminal bradycardia, and an emergency cesarean section was performed after maternal intubation. The umbilical cord pH was 7.04, BE was − 8.5, and APGAR scores were 1, 6, and 7. Birth weight was 2745 g (35 th percentile). The neonate received hypothermia treatment and non-invasive ventilation. After five days in the NICU and a total hospital stay of 16 days, the baby was discharged. Long-term follow-up is unavailable.

Trends over time

Over the 21-year period analyzed, there has been a noticeable increase in the frequency of VBB, with the most significant rise occurring in the past decade (▶ **Fig. 2**) when almost 40 % of patients were opting for intended VBB.

Discussion

We analyzed 21 years of data on breech deliveries in a Tertiary Perinatal Center in Germany to provide recommendations for counseling future patients on the optimal mode of breech delivery. Our cohort revealed a planned CS rate of 78.8% and an intended VBB rate of 21.2%. Among those aiming for VBB, 78% achieved a successful vaginal delivery. Across Europe, the success rate of VBB varies widely, with planned CS rates ranging from 40–90%, depending on national guidelines [9, 10]. Notably, our data shows an increase in intended and successful VBB, particularly in the last decade. Compared to national data, where 87.5% of breech presentations result in CS [11], around 40% of patients in our cohort opted for VBB in the recent ten years.

History of VBB at our center

The introduction of VBB at our center began over 20 years ago in response to a lack of hospitals offering this delivery option. Previously, breech deliveries often took place in unsafe settings without adequately trained obstetricians or neonatologists, resulting in adverse neonatal outcomes and frequent NICU admissions. Some patients seeking VBB even resorted to home births due to the unavailability of hospital-based care with trained staff. This situation highlighted the need for a safe hospital setting for VBB, with trained obstetricians and neonatologists available around the clock, laying the foundation for the VBB program at LMU Klinikum.

Our data show that, over the observed 21-year period, 37 obstetricians managed VBB. Notably, more than 80% of successful VBB were performed by just ten experts, each with experience delivering ten or more VBB. According to a Delphi consensus, competency in VBB requires an initial 10–13 breech deliveries, with 3–6 per year to maintain proficiency [12]. The continuous availability of skilled obstetricians greatly enhances patient counseling and confidence in the option of VBB.

A strength of our study is the extended 21-year observation period in a center with two independent delivery units. However, our data does not capture staff turnover or the extent of knowledge transfer to subsequent generations. Structured training, simulation, and education programs are essential to preserve and enhance VBB skills [13]. This is particularly critical as VBBs can occur unexpectedly, such as in multiparous women or in twin deliveries where the second twin presents in breech [14, 15].

As emphasized by the RCOG top-green guideline, “selection of appropriate pregnancies and skilled intrapartum care may allow planned vaginal breech birth to be nearly as safe as planned vaginal cephalic birth.” [16]. Our data reveals a high rate of successful VBB among multiparous women, especially those with a history of exclusively vaginal births. Consistent with other studies, VBB success is higher among multiparous women, especially those with prior vaginal deliveries and lower BMI [3, 17]. However, even in multiparous women, a trained team must be available to ensure safe VBB. Overall, our study population demonstrates a broad spectrum of inclusion criteria with the counseling obstetrician playing a key role in decision-making. FGR and head-to-abdomen circumference divergences were defined as exclusion criteria as growth-restricted fetuses are known for a higher risk of perinatal morbidity and mortality. Weight estimation in FGR is challenging [18], which may explain the higher number of FGR cases with birth weight below 10 th percentile in the group of VBB.

At the start of our VBB program in 2001, there was no strict protocol for the management of breech deliveries, and individual obstetricians applied their own strategies. The use of MRI pelvimetry was also debated, as the benefit of MR-pelvimetry in predicting of successful VBB is not clear until nowadays [19, 20, 21]. Over time, delivery protocols evolved in line with emerging international literature, such as recommendation for the upright position during breech birth [22]. Standardization of practices and teaching protocols are highly recommended and essential to ensure consistency and to further develop our center of excellence for breech deliveries [7, 23].

Maternal autonomy in choosing the mode of breech delivery is crucial. Studies underscore the importance of informed choice when deciding between CS and VBB [24, 25, 26]. The increase in planned VBBs in our cohort reflects this trend, as does the higher rate of ECV among the VBB group. While ECV was offered equally to all patients, the higher rate in those seeking VBB likely reflects the desire for a vaginal birth. ECV, recommended at ≥ 36 weeks of gestation [8, 16, 27], reduces the prevalence of breech presentations at term. German guidelines recommend the importance of open discussions regarding the mode of delivery for breech births [8], promoting informed maternal decisions and the selection of experienced providers for VBB. With our center’s concentration of skilled VBB providers, patients in the Munich metropolitan area increasingly seek our unit for breech deliveries, contributing to the rise in VBBs on our delivery ward.

Limitations

Each birth is unique, and comparisons of outcomes can be challenging, particularly when analyzed retrospectively using statistical methods. The TBT findings, which associated VBB with poorer short-term neonatal outcomes, reinforced the preference for CS in breech cases [28]. However, subsequent critiques of the TBT’s methodology [29, 30, 31] highlight the need for cautious interpretation, particularly regarding long-term neonatal outcomes, which our study did not address as well. While our data show better short-term outcomes for CS in terms of APGAR scores, umbilical cord pH, and NICU transfers, they are limited to immediate postpartum measures and do not evaluate long-term effects. Long-term effects are reported to be independent from delivery mode regarding children at the age of four years [32].

Recent meta-analyses report higher perinatal mortality and morbidity risks with VBB but also note increased maternal morbidity associated with CS [33]. In our cohort, VBB was associated with significantly lower maternal blood loss and shorter hospital stays. However, long-term maternal outcomes, such as rates of scar pregnancies, abnormal invasive placenta, uterine rupture in subsequent births, urinary incontinence, and pelvic organ prolapse, remain unexplored and must be considered in further studies [34, 35]. A Finnish study even showed that a CS for breech presentation in the first pregnancy is associated with adverse neonatal and maternal outcomes in the subsequent delivery [36].

Neonatal adverse outcomes in the VBB cohort were higher and warrant further discussion. HIE, while rare and occurring in 1.5 to 2.5 per 1000 live births, remains a recognized complication in term infants. Beyond VBB, risk factors for HIE include cord prolapse, shoulder dystocia, uterine rupture, placental abruption, and placenta previa [37]. Despite widespread use of CTG and a significant increase in CS for non-reassuring CTG patterns, the rate of cerebral palsy has not decreased in developed countries in recent decades [38]. An analysis of the four HIE cases in the VBB cohort revealed non-reassuring fetal heart rate patterns. Depending on the stage of labor, the leading obstetrician faced the difficult decision of whether to proceed with CS or continue with vaginal delivery.

In one case, emergency CS was performed as the cervix was not fully dilated, and HIE was diagnosed. Performing a CS is not always avoiding an unfavorable fetal outcome. In the second stage of labor, however, the decision to proceed with vaginal birth becomes more complex, as emergency CS may not always be the quickest option for delivery. Unlike cephalic presentations, where vacuum delivery can expedite the second stage, active extraction in breech deliveries is contraindicated due to the risk of worsening outcomes. A retrospective analysis of one HIE case that resulted in neonatal death prompts critical reflection on the decision to proceed with vaginal delivery, even knowing of the mother's prior spontaneous vaginal delivery. However, pathological CTG tracings, a difficult fetal extraction – including challenges with arm and head development – led to low APGAR scores and severely reduced umbilical pH measures. A retrospective analysis of this case calls for critical reflection on the decision for vaginal delivery even in multiparous women.

Overall, all HIE cases in our cohort occurred under the leadership of experienced obstetricians, with neonatologists present at birth, which are mandatory conditions at our center. It is crucial that breech births are overseen by an experienced team, and that the decision to proceed with a secondary CS in cases of CTG abnormalities or prolonged labor is made more promptly compared to cephalic presentations. This approach helps minimize the risk of poor fetal outcome.

To improve VBB outcomes, targeted root cause analyses of adverse events are imperative [3]. Tools such as "morbidity and mortality conferences" enable institutions to learn from individual cases and systemic errors [39]. At our center, these tools were used to review all VBB cases, particularly those involving adverse perinatal outcomes, including neonatal death and morbidity. Given the elevated risk of neonatal adverse outcomes in breech births, availability of neonatologists and NICU facilities is crucial. Early intervention is critical for neonates with HIE, as the therapeutic window for hypothermia treatment is limited [40].

As Hofmeyr et al. noted in their Cochrane review [41], the reduced neonatal morbidity associated with CS must be weighed against increased maternal risks. Ultimately, prioritizing each patient's informed choice, grounded in a thorough understanding of the risks and benefits of each mode of delivery, is essential [42].

Conclusion

Our study highlights the value of historical data in shaping a future where women can make informed choices about their mode of delivery in cases of breech presentation.

By analyzing over 20 years of data, we observed a shift from a predominantly cesarean-focused approach to one that includes VBB as a viable option in hospital settings. This shift underscores the need for open discussion about the best delivery mode and skilled providers among obstetricians and neonatologists to offer VBB. Among women attempting VBB, success rates at our center were high, with favorable maternal and neonatal outcomes when timely cesarean decisions were made in response to clinical indicators. Ensuring that women have the option of an informed choice in breech delivery depends on ongoing efforts to maintain and transfer the specialized skills required for safe VBB practice.

Contributors' Statement

Conceptualization: JB, TS. Data curation: JO. Formal analysis: JO, JB. Methodology: JB. Project administration: JB. Resources: JB, JO, TS. Supervision: SM. Validation: TK, LH. Visualization: JO, JB. Writing – original draft: JB, TS. Writing – review & editing: JO, LH, TK, SM.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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